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Abstract
This paper contributes to the discussion on information and communication technology (ICT) for educational purposes. Research was done on the use a virtual learning environment (VLE) based on Internet technology during a practical course for economic students at the Vrije Universiteit Amsterdam. The VLE has been used for many different purposes such as to support team learning, to inform students about course-specific issues, to support communication between students, to publish students' results, and to evaluate the assignments. The paper discusses the various learning and teaching processes that took place and the influence of using the VLE on these processes. It is argued that the use of the VLE for educational purposes is dynamic as it might influence learning and teaching in various different ways

Introduction

A lot has been written about the possibilities of ICT in educational settings. Much of these writings approach the subject from either a technological deterministic point of view (e.g. Barnard 1997, Denning 1996, Duchastel 1996) or from a social deterministic point of view (e.g. Hoffman and Ritchie 1997, Hannafin and Land 1997). From a technological deterministic perspective, the researcher looks at a technology as having effect on its surroundings; i.e. ICT influencing teaching and learning. A social deterministic perspective on the other hand argues that technologies are the result of human need and human choices how to satisfy these needs; ICT in this view is the result of information needs of the users. Both perspectives however fail to acknowledge the unpredictable emergent character of IT within education. Such an alternative perspective takes the standpoint that usage and consequences of IT emerge unpredictably from complex social interactions (e.g. Barley 1986, Ciborra 1996).

We believe such an "emergent perspective" (Markus and Robey 1988) is most appropriate to study ICT for educational purposes. An emergent perspective will help us focusing on how actors make use of various technologies during ongoing educational processes, how these uses differ among each other and how the technologies acquire their meaning over time.

Apart from a technological or social perspective, most of the papers on ICT and education are mainly theoretical or predictive and often a combination of the two. Little has been written based on empirical research findings. The aim of this paper is to explore the dynamics of VLE during education while studying the topic from various angles as to allow for unexpected findings. In order to do so, the central question that informed the research and also informs the structure of the paper is rather open and general: *What is the role of VLE during educational processes?*

The paper presents case study findings on the use of a VLE by university students attending a practical course on Information Systems. The course has been monitored from its start (September 1997) to its finish (December 1997). In the first section of the paper we will introduce the research design and a description of the organization of the course. Subsequently, we will clarify some of the concepts that are used throughout the paper. This will be followed by a discussion of the findings of the case study. The paper ends with concluding remarks such as tentative findings and propositions for further research.

Research Design

An emergent perspective calls for exploratory research in which the use of IT is studied in situ; explaining how and why ICT is used as such (Markus and Robey 1988). In order to analyze in more detail the complex and emergent nature of the phenomenon under study, we made use of triangulation or the use of various research instruments at the same time. Various units of analyses were used: students' and instructors' posting on the website of the course (bulletin board, chatbox, discussion groups, etc.), time logs, observations during class meetings, observations of meetings of various team, interviews with students and teachers, diaries kept by a selected group of students, and a (longitudinal) survey of all students attending the course. Three times during the course, in August, October and December, all students were asked to fill in a questionnaire. The first questionnaire was meant to measure the past experiences of students. Out of the other tools of analyses, new questions emerged which were added in the following two questionnaires.

Organisation of the course

The practical course is focused on 'Application of IT in the financial sector' and discusses how ideas taught during the preceding lectures on 'Information Systems' can be used in practice. The main objective is to teach students to generate ideas about using IT in an organisation and to discuss the impact IT can have on the organisation and its business environment. Hundred and twenty students that are divided over six classes followed the course. These classes came together weekly to discuss the results of the assignments. The classes were split into five teams of four students that together work out the assignments. Each team represented an organisation and worked out the assignments for their organisation. Organisations were for example: bank, insurance company, security broker, etc. The normative time expenditure was about 12 hours per week per student.

The course was supported by a course wehsite (http://www.econ.vu.nl/vakgroep/bik/wcis97/). This website was used to support information exchange and communication relevant to the course. The website was used by teachers to publish weekly assignments, routine businesses, student grades, etc. Each team published its weekly completed assignment on the website. This means that the results were accessible to all other students and teachers. The site also enabled the communication between students by providing specific interactive functionality's such as a bulletin board, a chatbox, discussion lists and a page to publish relevant URL addresses.

Conceptual issues

Users of the VLE can publish information on the course's website, communicate synchronously via chatboxes and newsgroups, or a-synchronously through for example the use of electronic mail or electronic bulletin boards, and obtain all sorts of information from the World Wide Web. These functionalities of the Internet seem to be attractive to educators, especially at those educational institutions where Internet membership is free. Some of the reasons for the use of Internet into classrooms includes increasing the ability to search and obtain (global) information (Dyrli 1993) and facilitating communication through discussion group features of the Internet (Downing and Rath, 1996). Next to the gathering, publishing and communicating facilities, the Internet provides educators with an infrastructure that can be used to create tools to support the communication between the students and teachers. Such tools are also used to build Intranets in corporate settings, or private networks based on Internet standards and protocols. The concept of Intranets, that of using Internet infrastructure and technology to create local communication and organisation, is one that seems to lend itself well to higher education (Downing and Rath 1996). In this paper we report on the use of the Internet and Internet-technology based tools during a practical course at a university.

The practical course was organised as or project-based education. Group-based project work is a frequently used instructional strategy that allows the tackling of a complex task, too complex for one person to handle alone. It also provides learning experiences in group interaction, providing opportunities for students to articulate and defend their ideas and to reach consensus on decisions as well as on work-flow management (Collins et al, 1997; Guzdial et al, 1996). At the practical course under study the group-based nature of the work was articulated by the fact that the team instead of the individual was responsible for the work and that the grades were given to teams instead of to individuals.

This organisation of the course allowed for ***team learning*** within teams and sometimes also between the teams. Team learning can take two forms: ***co-operative learning*** or learning from each other and ***collaborative learning*** or learning with each other. Collaboration is distinguished from co-operation in that co-operative work "... is accomplished by the division of labour among participants, as an activity where each person is responsible for a portion of the problem solving...", whereas collaboration involves the "... mutual engagement of

participants in a co-ordinated effort to solve the problem together" (Roschelle and Teasley, in press) As we will discuss in this paper, co-operative learning was directly supported by the VLE as it enabled feedback and peer-review whereas the VLE only indirectly supported collaborative learning.

The organisation of the course also allowed for the learning of three conceptually different kinds of knowledge-fields that in practice are often intertwined: *embodied knowledge, embrained knowledge and enculturated knowledge* (Blackler 1995). Embodied knowledge is 'knowledge about' (James 1950) and depends on cognitive abilities. Embrained knowledge is 'knowing how' (Ryles 1949) and is action-oriented such as skills. Enculturated knowledge refers to shared understanding and is mostly of a tacit nature, and concerns aspects such as language, symbols, rituals, norms and values. Learning often involves learning of a combination of these three types of knowledge.

Findings

In general, the way the Internet was used during the particular course under study influenced the communication between teacher and students, among students and among teachers. In some occasions, the Internet substituted the communication, in other occasions its influence was indirect. We will present the findings of our case study with the use of a two by two matrix referring to the various streams of communication (see Table 1).

Table 1 Types of communication

		to	
		student	**teacher**
from	**student**		
	teacher		

The upper left cell indicates student to student communication, some of which refers to team learning and will be given the most attention. The lower left cell concerns communication between the teacher and the student and consequently refers to teaching. The lower right cell concerns the communication among the three teachers which was not directly supported by the VLE but was influenced as a result of the open or public character of the VLE. The upper right cell concerns communication from students to teachers with the use of the VLE. We will start the presentation of the findings by first discussing the content of the last three cells in combination, followed by a separate section dealing with student to student communication.

Communication with and between teachers

Teachers communicated with students in four ways: during class meetings, personally before or after the course, with the use of the communication tools of the VLE. and through the course website.

Most of communication happened during the weekly class meetings on Friday. During these meetings, the teacher discussed the results of last week. Two teams presented their results, mostly making use of traditional means as overhead projector and chalk-board. After the presentations questions regarding the presentation were asked and answered. Following this, the discussion was directed at the issues that the teachers initiated. In the morning before the class meeting, the teachers guiding the course by reading through the results of the students and extracted issues directly related to the results or more general topics that were to be discussed in the class meeting. The class meeting ended with the introduction of the assignment for next week.

Communication between students and teachers also happened personally outside the classroom and was mostly initiated by students visiting the teacher in his office. The use of the communication facilities offered by the Internet was used sporadically. Although 76% of the students indicated at the start of the course that they thought the use of electronic media such as e-mail would enable communication with teachers, only a few students actually made use of this mode of communication.

The course website provided possibilities for teachers to communicate course-relevant information to students. Next to the interactive communication tools to which we return later, the course website contained a news page, a page containing a description of the course, the assignments for the week, and a site containing help for publishing on the web. Furthermore the site included a page where all the teams weekly published their completed assignments. Table 2 provides an overview of the average hits per week.

Table 2 Average number of hits

Course web-site page	Av
Newspage	440
Assignments	168
Internet tools	19
results (team index)	267
discussions page	60
links page	60
bulletin board	67
Chatbox	40

The 'News *page'* site can be seen as the general bulletin board where teachers posted messages relevant to all students. This page has been frequented most often, which is due to the fact that it is the default page of the website. At the end of the course the page contained 19 messages of which 11 were hyperlinks to the assignment of the week. The other 8 messages concerned news about the course website, additional information about the assignments, a reference to an article, the mid-term and end-term grades, and a job advertisement for student assistants.

Every week, one of the teachers added a description of the assignment of the week on the site labelled *'ussignmenr'.* Mostly, students were referred to this site as to know the assignment for next week. There are some advantages of publishing the assignment compared with telling it during the course, which was done during previous years. Besides of the problem of forgetting the exact assignment, there was no difference between teachers; every group has the same assignment. Furthermore, teachers often discussed after the course what the assignment of next week would be. As for previous years in which the assignments were given during the course, this has the advantage of adjusting to the results of previous assignments.

The *'Internet tool'* page contained references to information about how to use HTML, how to make web pages and how to use web pages. Obviously, this side was mainly used during the beginning of the course. During the first month the page was visited on average 45 times per week, during the last month, visitation dropped to 8 hits on average per week.

Every team created their own website that could be found under the page 'Results'. These 30 websites contain a collection of all the weekly assignments. On average the result page has been visited 267 times a week. However, this figure does not give the exact number of times students' websites were visited because there were other ways to get to the students' pages.

The communication between the teachers was not directly supported by the VLE. However, publishing the assignment on the website asked for more discussion between the teachers as there could be less variance between the assignments the teachers gave to students. Another effect of the use of the VLE is that teachers have easier access to the results of other teacher's teams. This supported learning from each other.

Student to student communication

Obviously, not all communication between students involved learning as most communication merely involved the exchange of information without a change of existing knowledge. Below we report on findings about the use of ICT that potentially could influence the learning between students.

The formal purpose of the course was to learn more about certain specific aspects related to IT (Business Process Redesign, Virtual Communities, and Digital Money) within financial organizations. Whether students successfully learned this *embrained knowledge* can only be measured by subjective measurements such as the average mark the teachers graded the students (7 on a scale of 1 to 10) and the self-assessment of their learning (see Table 3). Most students believed that they had more knowledge about the financial sector than students that did not take the course. That this refers to the knowledge learned during the course and cannot be attributed to individual aspects only becomes clear when we observe that most students believed that there is no difference in knowledge between them and other students who did take the course. It should be noted however that this answering pattern does not reveal a normal distribution, which might indicate that students are not able to assess correctly their acquired knowledge relative to other students.

Although not formally stated, another possible outcome of the learning process was the construction of *embrained knowledge* or knowledge about the use of the Internet. Again, only teachers rating of the evaluation of the layout of the website and web use, as well as self-assessment can tell us more about the learning of these types of embodied knowledge. On average, teams were grated a 6,7 at the end of the first six weeks and a 7,3 at the end of the last six weeks. Students also thought they had learned during the course, as indicated in Table 3.

80% Of the students perceived themselves as more competent in the use of Internet technologies than students who did not signed up for this course. Again, these results refer to the knowledge learned during the course and cannot be attributed to individual aspects only: 57% perceived no difference among students who did take the course. Again, some reservation is needed since students tend to assess themselves as being better than other students.

Table 3 Self-assessment of learning (December 1997)

"I have the feeling (generally speaking) to have more/less knowledge about IT and the financial world than other (comparable) students that did not assign for this practical course."	**71%**	**25%**	**1%**	**3%**
"I have the feeling (generally speaking) to have more/less knowledge about IT and the financial world than other students who are taking this practical course."	**23%**	**69%**	**8%**	
"I have the feeling (generally speaking) to be more/less competent in the use of Internet technologies than other (comparable) students that did not assign for this practical course.'*	**8** 1%	**12%**	**1%**	**6%**
I have the feeling (generally speaking) to be more/less competent in the use of Internet technologies than other students who are taking this practical course."	**32%**	**57%**	**11%**	

While learning new facts or new practices, we simultaneously tend to learn more implicit aspects that are related to the embodied and/or embrained knowledge we learn. For example, when students learn about management while using textbooks, they implicitly learn *enculturated knowledge* from the pictures, the examples given and the language used, that managing is predominantly a masculine activity. Or, while learning on the job, the apprentice also learns the implicit rules of becoming a full member of the specific group or organisation. Learning this type of knowledge is even more difficult to get hold on and to measure. While discussing team learning in more detail below, we will also discuss how VLE effected learning of enculturated knowledge.

Although the course was organised as a group-based project, not all the learning can be characteriscd as team learning. On average, students spend 30% of their time working solitary on the assignments. The remaining 70% were spent either on co-operative learning or collaborative learning. Below we will discuss the three types of knowledge that are learned during co-operative and collaborative learning.

Co-operative learning

Co-operative learning took place in those cases that students learned from each other. Every Thursday afternoon, all teams had to publish their completed assignment for that week on the website. Consequently, all students and teams were able to learn from each other. Sometimes this learning occurred purposefully as teams were asked by the teachers to review the work of other teams and to give these teams feedback. Sometimes, this access to the work of others created situations in which students merely copied work from each other. Since a process of internalization did often not follow this knowledge acquisition, copying did not have much to do with learning. The following excerpt provides an illustration of such copying behavior.

(Observation a team meeting with Jos, Jan, Tinus and Wim. Wim is reading from the screen the feedback other teams have given to their assignment of last week. Tinus sits behind Wim. Jos and Jan are just returning from the library having searched for information they could not find on the Internet. On their way back they have bumped into some members of team 8 who told them they already finished their assignment)
Jos (entering the room): "Group 8 already finished their work. "
Tinus: "well let's search for it"
(Tinus is searching the website of team eight, others are watching him doing so)
Jos: "just a matter of cutting and pasting "
Tinus copies part of the site to their own site, others laugh when Tinus is ready
Tinus: "oohhh, cool man"
Wim: *"yesss!!"*
Tinus: "they will surely see this when they are going to review our.. "
Jan: "so? that doesn't matter does it?"
Tinus: "no" (while typing:) "thanks to... "

Jos: "group 8"
Tinus: "yes, lets add that"
Wim: "it saves a lot of extra work"
Tinus is reading the text
Tinus: "its a very nice story, do you want to read it"
Jos: "no never mind".

Students positively valued this type of co-operative work (see Table 4)

Table 4 Acces to each other's results (October 1997)

"Access to the sites of other teams makes it more easy to assess the quality of our own work"	91%	6%	2 %	1%
"By having access to other sites of other teams, our own work improves"	75%	20%	3 %	2 %
"Reviewing the work of other teams gives extra value to the course"	68%	22%	9 %	1%
"I don't mind when other students copy information from our **site** and publish it on their own site"	**36%**	**29%**	25%	1%

After three months, teachers started to wonder whether the access to each other's work might have levelled out the knowledge among students. While in the previous year the access to each other's work seemed to have pushed students to work harder, this year the students seemed to put less effort in their assignments and seemed to express less know how on the subject. Maybe they should have intervened more directly in the co-operative learning process for example by laying down a desired standard. Without such intervention, they postulated, peer-review might level out the knowledge and collectively reduces the amount of effort students put in their work. In December, we incorporated three questions related to this in the questionnaire (see Table 5). Although it seemed that students agreed that levelling out did occur as a result of peer-review, we cannot be sure whether this has a positive or a negative effect on learning. After all, 76% of the students agreed that they have learned more by reviewing others. During interviews however, students expressed the negative effects of levelling out as a result of peer review, such as putting less effort in their work because teachers seemed to tolerate completed assignments of other teams that were of a lower standard. More research is needed on these effects of peer-review.

Table 5 Access to other's work and learning (December 1997)

	Agree	No difference	Not agree	Don't know
"By having access to the work of others, I could see the average effort among students to which I adjusted my efforts"	44%	23%	31%	1%
"By having access to the work of others, the knowledge among students levels out"	45%	22%	28%	5%
"By having access to work of other teams, I have learned more than I had in case there was no access to the work of others"	76%	16%	6 %	1%

Students could communicate with each other and as a result could learn from each other by using the interactive websites, such as the links page, the bulletin board, and the discussion lists. The links page was designed for links to various relevant topics: the Internet, the Financial Sector, BPR, Digital Money and Virtual Communities. The page was supposed to be filled by postings of teachers and students of linkages to URL pages of relevant pages on the Internet. Students did not seem to have great interest in actively posting information on the page (of the 60 postings, 14 were done by students), nor in visiting this page (see Table 6). These results do not imply that students did not refer to other sites on the Internet. In fact, the students' completed assignments contained links to more than 500 different pages on about 300 websites world-wide. The reasons for not posting these pages on the links page in order to make them easily accessible for other students are not clear. Some students indicated that it requires extra work for which compensation is not given, others argued that they are not able to assess whether a page is valuable enough to publish it on the links page.

Table 6 Number of hits per week

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	total
news	808	913	773	627	498	112	241	274	462	389	361	354	224	125	6161
assignments	291	271	279	185	222	28	64	150	204	204	170	181	77	24	2350
results	507	581	418	367	322	70	191	163	273	194	225	256	133	41	3741
internet help	62	53	45	18	11	11	7	13	10	6	15	8	4	8	271
links	97	103	81	46	158	26	29	58	79	39	35	48	20	14	833
discussion lists	99	70	153	47	44	15	15	23	25	122	109	57	40	18	837
postings	123	137	145	80	77	25	30	51	67	51	49	48	35	25	943
chat	104	114	93	44	32	21	9	15	27	22	26	24	19	10	560
total	2092	2244	1990	1418	1369	314	593	755	1156	1037	1001	988	565	279	15696

The discussion list is a page where students are able to communicate a-synchronously about course-specific topics. This page was divided into the same topics as the links page. Students did not visit this particular page often (see Table 6) and seldom started a discussion or joined an existing discussion. In order to stimulate the use of the VLE as well as to let students learn what it is to discuss electronically, teachers asked them to actively contribute to the discussion list. The rise of hits and contributions increased drastically during that specific week. In total 190 questions and answers were published on the site, of which 71% were published in the week that publishing was obligatory. This rise of usage did not change the attitudes of the students. In fact, after the use of the discussion list was no longer compulsory, visits dropped to the average of 38 hits per week.

The bulletin board is a page where students can publish questions and announcement of a more general nature. The usage of this page corresponds to the use of the previous two page. On average student visited this page 67 times per week. 45 Messages were posted, half of which where anonymous (see Table 7).

Table 7 Use of bulletin board

Category of message	Personal	Anonymous
Tips	3	2
Announcement Teacher	4	-
Announcement Student	7	-
Nonsense	-	6
Response to nonsense	-	6
Questions	7	-
Complaints	2	8

Students also indicated that they had not learned much from using the interactive website as is shown in Table 8.

Table 8 Value of interactive tools (December)

	Agree	No difference	Not agree	Don't know
"Asking questions and giving answers via the discussion lists and/or the bulletin board has increased my knowledge about IT and the financial sector"	18%	24%	55%	3%

An obvious explanation for the limited use of the interactive website is the more general problem of access to computers. Although students had access to computers in three computer labs, the most severe handicap during the course was the limited amount of available computers. Students often had to wait to get access to a free computer. This discouraged spontaneous log-ins as to check e-mail messages, to check the course website or to surf on the World Wide Web. In fact, at the end of the course, 91% of the students indicated on the questionnaire that access to computers had hindered carrying out the weekly assignments.

Another obvious explanation is the lack of a felt need. Because students saw each other almost daily and because most students knew each other personally, there was no need to electronically support this communication. In other words, the existence of a personal communication culture limited the need for electronic communication.

Another possible explanation is the general reluctance among students to do something extra which does not influence the end grades. This also explains why the discussion site was mainly used during the week its use was obligatory.

While learning from the sites of other teams, students learned at the same time some "computer/Internet" skills or *embodied knowledge* from each other. For example, they learned how to improve the design of their own website by copying a specific layout of another team's website. Also within teams, students learned from each other how to work with the Internet. A majority of the students learned Internet tools from other students (see Table 9).

Table 9 Sources used to learn bow to design and maintain websites (October 1997):

Internet tools on the course website	38%
Team-members	66%
Others (students or outside university)	62%
Manuals and other books	8 %
Other	5 %
I already knew how to make a website before the course started	14%
I still cannot create a website	8 %

This often happened by sitting next to another member of the team who already knew how to work with the computer. By watching him/her doing and asking questions, students learned Internet and computer skills from others. The following excerpt from an observation of a team meeting illustrates this type of learning in which an expert is teaching others how to work with websites:

(three team members: David, Michael and Willem, are sitting in front of one computer screen, David is in control over the keyboard and is publishing the results of their assignment on their website. David knows a lot about the Internet and enjoys working with it. Michael and Willem, are watching what David is doing.)
Michael: "what are you doing now?"
David: "what I want is that when this site opens, this will appear (points with his finger to a picture on the screen), so you link to the target and that is exactly were the picture will show up. "
Michael: "oh yeah "
David is working on it, others are following his actions quietly
Michael: "but I can remember you once did it by putting an address.. "
Willem: "yes. that's what he is doing now as well"
David: "you can link to an address, now you are linking to the webpage and within the webpage you link to the target"
Michael.. "oh I see"
A picture appears on the screen
Michael: (surprised) "where do you get that from?"
David: "from above, copy and paste "
Michael: "Are you sure that you can get the picture in total on the screen now, isn 't it better to put the target in the middle of the screen "
David: (puts the target in the middle of the screen) That's it. Let's put in on the net.

During learning from each other, students implicitly learn *enculturated knowledge.* Enculturated knowledge or knowledge concerning implicit assumptions, norms and values, was learned at the same time students were learning from the Internet and how to use the Internet. For example, in order to learn more about, for example, insurance companies, students used the Internet to scan various sites of insurance companies. Compared with a more personal approach such as a visit to an insurance company and interviews with people working within the world of insurance, information on the Internet is rather "flat". Consequently, while learning from knowledge gained from the Internet, students - often implicitly - copied the PR-style of writing that is typical for commercial sites on the World Wide Web. Also, while learning how to create a website, students learned implicitly the importance of the appearance of the site. While most sites of the teams were artistic masterpieces with sparkling letters and rotating logo's, less attention was given to the texts and its spelling and grammar - although this seems to occur in general. These findings correspond with the findings of Lawless and Kulikowich (1995) (cited in Lawless and Brown 1997) showing that certain users of multimedia environments are seduced by the "bells and whistles" of the computerised environment while paying less attention to text based information.

Also, while using the interactive websites such as the bulletin board, the links page and the discussion site, a certain electronic communication culture emerged. As Table 7 shows, of all postings on the bulletin

board 25% were not relevant to the course. Furthermore, half of the postings on the bulletin board and the communication page were anonymous which also made the interactive websites a less serious tool to exchange 'productive or relevant' knowledge. This culture might in turn discourage subsequent postings of more relevant knowledge.

Collaborative learning

Collaborative learning of *embrained* mainly happened during face to face group meetings, although this type of learning also occurred during the weekly meetings when students discussed issues in the class. As has been argued elsewhere (Daft and Lengel 1988), the most suitable environment for collaborative learning or learning together is where the learning actors meet each other personally. This is not only to exchange rich information but also that such environments make it possible for the occurrence of brainstorm-like situations, where people learn together through negotiations, loose associations, and serendipity (e.g. Bruffee 1995). Most of the collaborative learning that we observed took place during team meetings where students learned with each other.

In theory, collaborative learning might also occur electronically with the use of the chatbox. This chat-box was part of the course website and was designed for students to communicate interactively with one another. The chat-box was visited 60 times per week on average (see also Table 6). In the beginning of the course students often clicked on this item as to see who was chatting about what. They seldom actively started to chat or joined an ongoing chat. Students sporadically used the chatbox as a tool to support the communication of team members who could not meet each other in person. This happened for example when one (key) member of a team injured his leg and could not come over to the university. Team members agreed by e-mail at what time they all logged-in on the computer so that the collaboration could continue electronically. These particular students stated afterwards that they were surprised how effective the use of such electronic media is when working together on an assignment. As a result of the fact that students saw each other frequently, chatting with each other electronically was mainly seen as amusement.

Students also learned ***embodied knowledge*** together, for example by learning through trial and error how to use Internet tools. However, teams often consisted of one or two members who knew more about the Internet or who enjoyed working with it so that these members acted as the Internet-teachers of the group.

While learning embodied and/or embrained knowledge with each other, students also learned ***enculturated knowledge*** or implicit rules or norms about how to work together. Some teams consisted of students who had chosen to work with each other, other teams consisted of students who were brought together by the teacher. In the first situation, an already existing group-culture influenced the way students learned. For example, one team consisted of four male students who knew each other already for several years and even shared apartments. Over the years, certain implicit norms and values were developed such as trying to be as efficient as possible without putting much effort in the work. Also, they were much more tolerant towards each other and did not mind that one team member rarely showed up during team meetings. Their shared attitude towards their study influenced their attitude and usage of the VLE during the course. For example, this particular team did not use the interactive tools because they perceived it as extra work that did not influence their end-grades. In case teams were formed at the beginning of the course, a certain group-culture emerged out of the learning processes as described above. For example, certain team members worked highly individualistic whereas other teams were much more collaborative. In case the learning was mainly done individually through task specialization, students tended to make more use of electronic mail, for example to send their completed contribution to other team members. Team members who learned together, tended to make less or even no use of the communication facilities of the VLE.

An electronic communication culture also emerged while using the chatbox, as a potential tool to learn collaboratively. For example, the postings in the chatbox increasingly became more senseless, and - at least in the eyes of the researchers - from time to time vulgar and abusive. This did not stimulate others to start a serious conversation.

Table IO provides a matrix of the various types of learning divided by three types of knowledge.

Table 10 Various types of learning

Embodied knowledge (IT and the financial sector)	learning from teacher's lecture, from giving and receiving feedback, from using interactive websites, from sites of other teams	learning during the exchange of experiences and **ideas during team-**meetings, learning **during** student discourses in the class

Embodied knowledge (the use of ICT tools)	learning from using interactive websites, from copying other sites, from other students, learning by imitating others	learning by trying out collectively
Enculturated knowledge	Development of an electronic communication culture	development of group-culture

Concluding remarks

This paper presented some findings of an explorative study on the use of a VLE. We studied a group of students who used a learning environment based on the Internet during a course on information systems. The students published their work on the website of the course, gathered information from the World Wide Web (among which were information published by fellow students and information published by teachers), communicated synchronously and a-synchronously with the use of ICT, and use an infrastructure which was provided by the teacher to create a local environment on the Internet comparable with Intranets within corporate settings. We have used an emergent perspective while studying the topic and have also tried to present the findings as such. Conform an emergent perspective which postulates that technologies gain meanings the moment they are used in practice and in different settings, we studied how the VLE was used in practice without the research being guided by pre-defined hypothesis.

We found that the communication facilities, both a-synchronous as synchronous, were only sporadically used by the students. The most plausible explanation is the limited access to available on-line computers as well as the fact that students had the opportunity to meet each other regularly in person. Although obvious on hindsight, both students and teachers expected that the VLE would enable student and student-teacher communication (76% of the students believed at the start of the course that Internet would enhance communication with teachers while only a few students did indeed communicate with teachers through the Internet. Likewise, 73% of the students believed at the start of the course that Internet would enhance communication with other students while only a few students did indeed communicate with other students through the VLE). This illustrates that we should be careful with interpreting predictive studies on ICT during education; the use of ICT might well be different from what to expect when actually studied in situ.

Not only the frequency of use might differ from what is expected, also the purpose of using the VLE might be different. For example, many students only used the interactive pages of the course website as to comply with the wishes of the teachers rather than to communicate with other students as to exchange course-relevant knowledge. This way of using the VLE might be due to the hierarchical environment in which the website was used as well as the scholastic tradition in which many students who attended the course were trained. Other students used the interactive webpages mainly for amusement rather than for a functional exchange of knowledge. For example, over time the chat box and the bulletin board were mainly used as environments where students had the opportunity to express anonymously complaints about the lack of available computers, the course, the university in general and about other students, or to express course-irrelevant issues. Because of this specific use of the course website, most students did not visit the site in order to learn course-relevant knowledge from other students.

Another example which shows that the VLE has been used differently than intended and consequently shows the purpose of an emergent perspective on the topic, is the use of the Internet to 'cut and paste' the work of other students rather than to actually learn from it. Although teachers stimulated students to look at the completed assignments of other teams as to learn from it, they did not expect students to merely copy other work. Because of the explorative character of this particular study, findings need to gain further research attention. Below we will shortly present some findings that we believe to be of interest for further research.

1. Research is needed on the use of Internet in hierarchical settings such as educational institutions. It might be that the open, democratic character that many ascribe to the Internet cannot be shown to advantage in situation that are less open and free. Research is also needed on the various purposes for which teachers and students use the VLE.
2. More research is needed on the assumption postulated in this paper that learning with the use of the Internet involves three types of knowledge: embrained knowledge, or learning the content, embodied knowledge, or learning to use the technology, and enculturated knowledge, or learning norms, values and language (see point 5) from using the Internet.
3. More research is needed on the difference between collaborative learning and co-operative learning in relation to the use of electronic communication. In this study, we found that collaborative learning mainly

happened during face to face interactions whereas co-operative learning can be supported by electronic interactions.

4. From our research we believe that the use of a VLE has some democratisation effects. More research is needed on the possible effect of 'levelling out' as a result of having open access to the work of other students. More research is also needed on the effect of using a VLE on the power of teachers. The authority teachers used to have as a result of their possession of expert knowledge might decrease due to the open character of the Internet.
5. More research is needed on the opportunities that Internet offers to students to merely copy information from the Internet rather than to learn from it. Furthermore, research is needed on the effect of copying information from the Internet on the use of language by students.

References

Barley, S.R. (1986) Technology as an occasion for structuring: evidence from observations of CT scanners and the social order of radiology departments, Administrative Science Quarterly, 3 1, pp. 78-108.

Barnard, J. (1997) The World Wide Web and higher education, the promise of virtual universities and online libraries, Educational technology, May-June, pp. 30-36.

Blackler, F. (1995) Knowledge, knowledge work and organizations: an overview and interpretation, Organization Studies, vol 16/6 pp. IO2 I-1046.

Bruffee K A 1995, Collaborative learning: higher education, interdependence, and the authority of knowledge, Baltimore MA: Johns Hopkins University Press

Ciborra, C. (ed) (1996) Groupware and teamwork, Chichester: John Wiley & Sons Ltd.

Collins, B., T. Andernach, and N. van Diepen (1997) Web Environments for Group-Based Project Work in Higher Education, International Journal for Educational Telecommunications, 3(2/3);

Daft, R.L. and Lengel, R.H. (1986) Organizational information requirements, media richness and structural design", Management Science, vol 32/5 pp. 54 l-57 1.

Denning, P.J. (I 996) Business Designs for the New University, Educom Review, november/december, pp. 2 l-30.

Downing, C.E. and G.J. Rath, (1997) The Internet as Intranet: Moving towards the electronic classroom, Journal of Educational Technology Systems, vol 25/3, pp. 273-29 1.

Duchatel, P. (1996) A web-based model for university instruction, Journal of Educational Technology Systems, vol 25/3, pp. 221-228.

Dyrli, 0. (1993) The Internet: Bringing Global Resources to the Classroom, Technology and Learning, vol 14/2, pp. 50-57.

Guzdial, et. al., (1996) Computer support for learning through complex problem solving. Communications of the ACM, vol 39/4, 43-45.

Hannalin, M.J. and S.M. Land (1997) The foundations and asssumptions of technology-enhanced student-centered learning environments, Instructional Science, vol 25, pp. 167-202

Hoffman, B. and D. Ritchie (1997) Using multimedia to overcome the problems with problem based learning. Educational Technology, vol 25, pp. 97-115.

James, W. (1950) The Principles of Psychology, New York: Dover.

Lawless, K.A. and S.W. Brown (1997) Multimedia learning environments, Issues of learner control and navigation, Instructional Science 25, pp. 117-131

Markus, M.L. and D. Robey (1988) Information technology and organizational change: causal structure in theory and research, Management Science, vol 34/5, pp. 583-598.

Roschelle, J. and S Teasley, in press, The construction of shared knowledge in collaborative problem solving, in C.E. O'Malley (ed) Computer supported Collaborative learning, Heidelberg: Springer-Verlag

Ryles, G. (1949) The concept of mind, London: Hutchinson.